New Data Show Methane in Pennsylvania Water Wells Unrelated to Hydraulic Fracturing

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Overview: *Methane in GW in Northeastern PA*

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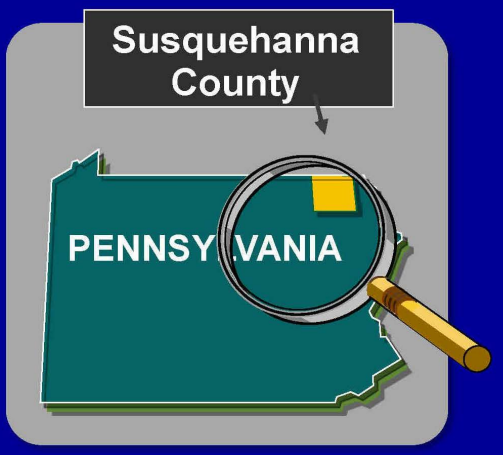
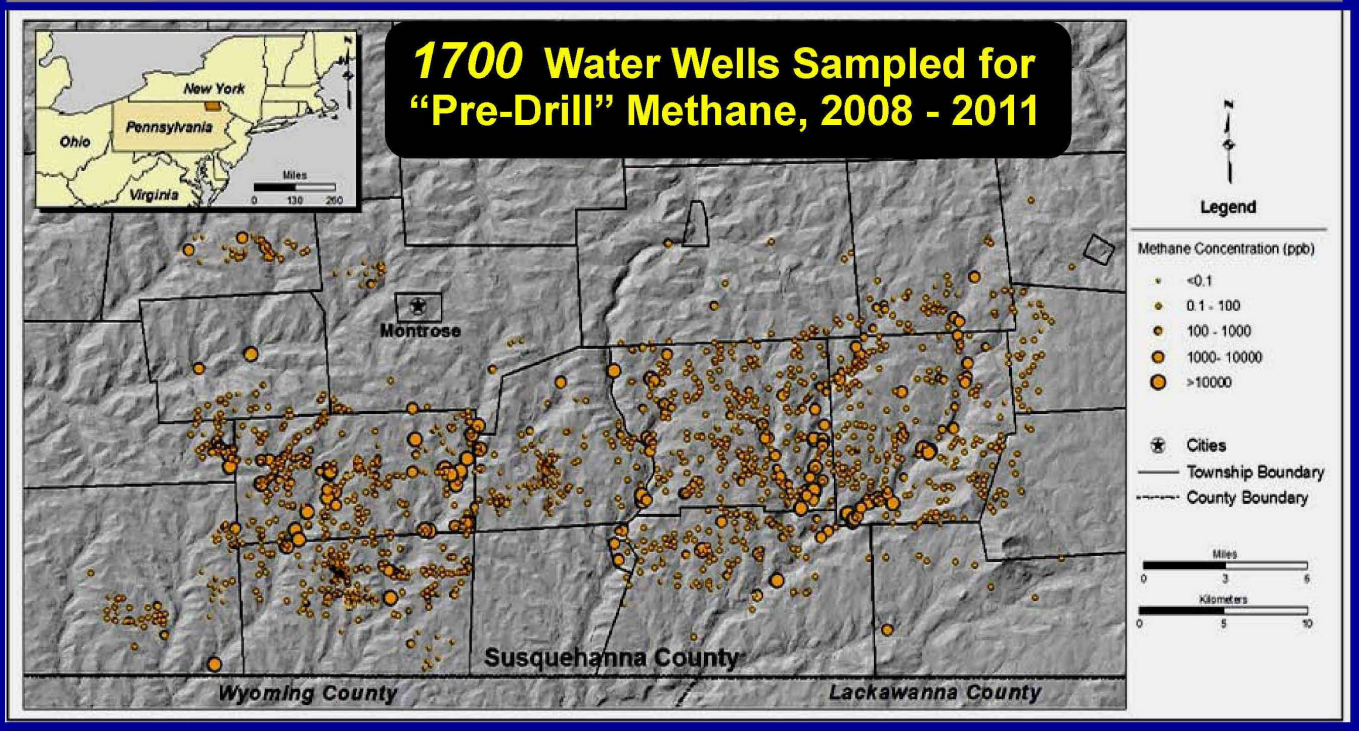
- ***Pre-Drill Methane Survey: Susquehanna County***
- Geologic and Historical Background
- Overview: PNAS Osborn et al. (2011) Study
- Isotopic Signatures of Source and Impact Gases in Susquehanna County
- Similar Case: *Parker County, Texas*



Methane Impacts In GW in Northeastern Pennsylvania:
Regional Survey of "Pre-Drill" Methane in Water Wells



KEY FINDINGS:

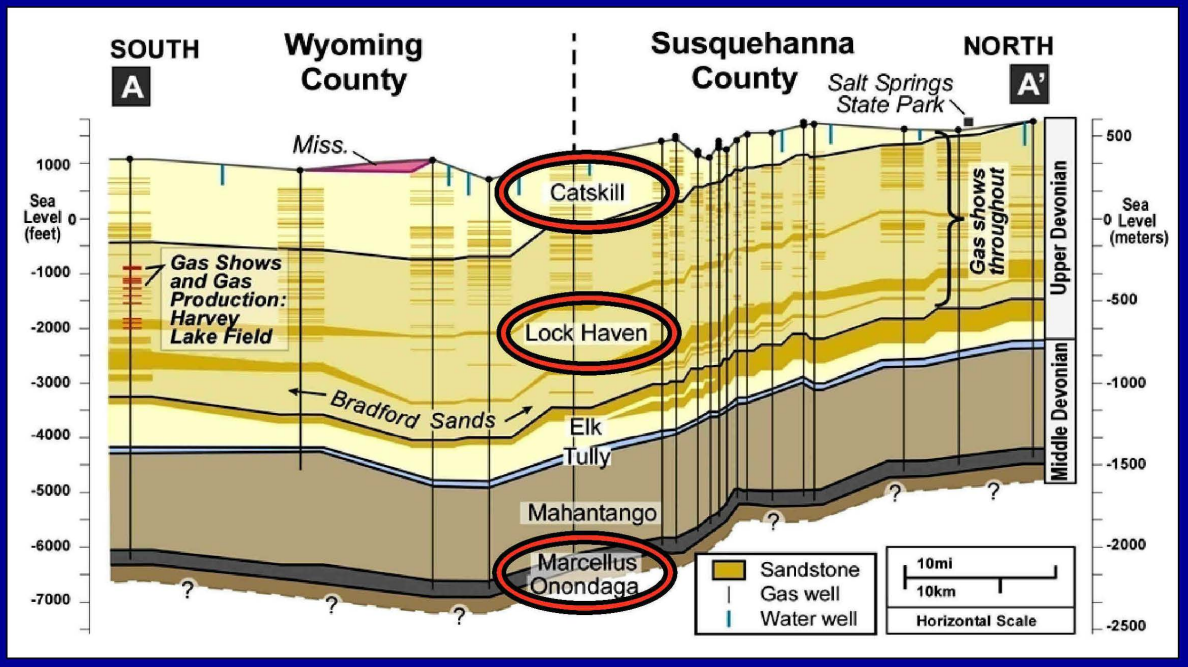
- 80% of water wells contain methane
- Higher methane levels in valleys vs. uplands
- No correlation with gas production areas

Underlying Geology of Northeastern PA

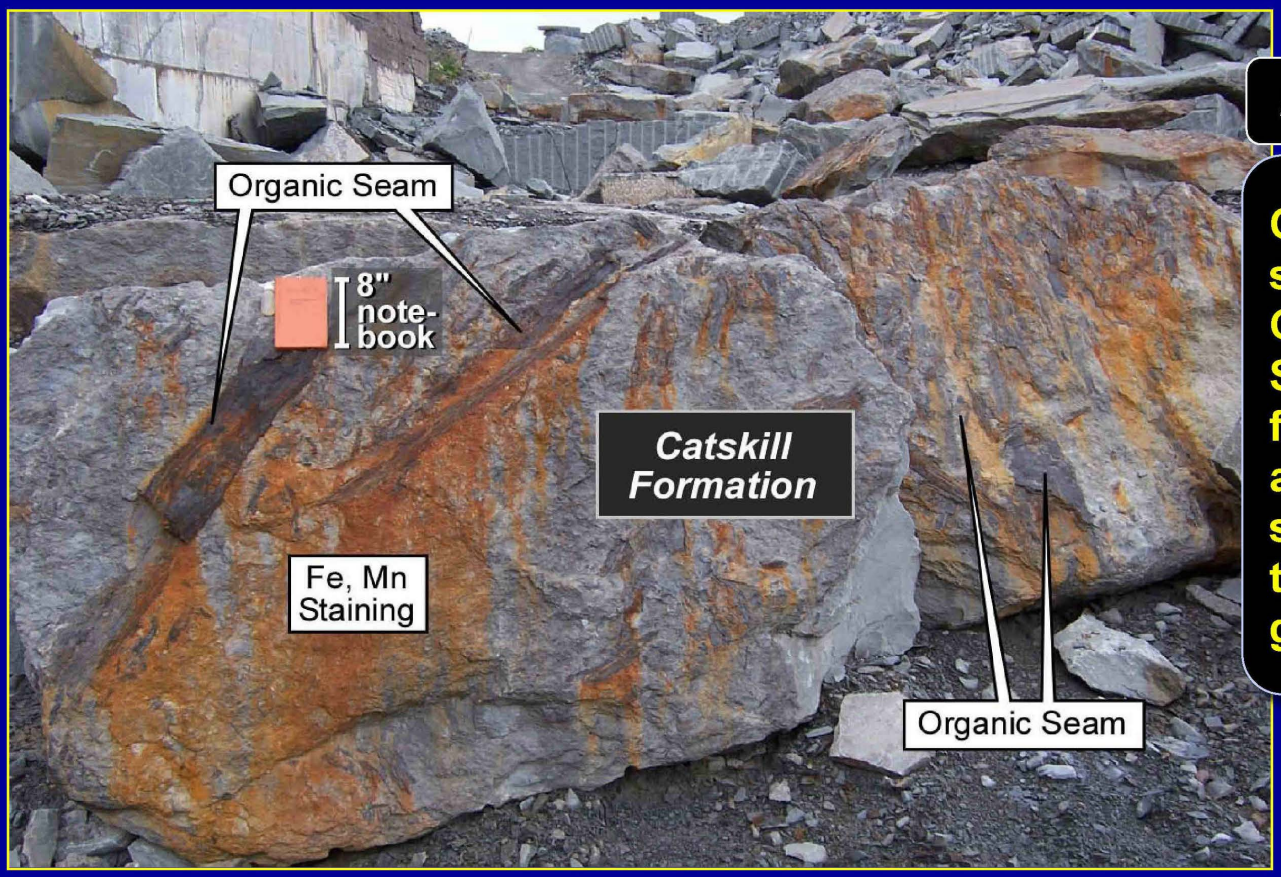
Key Strata

- ***Glacial Till:*** Contains microbial gas
- ***Catskill & Lockhaven Formations:*** Thermogenic gas-charged sandstone deposits (with extensive fracture network)
- ***Marcellus Shale:*** Gas at ~6000 ft below surface.

Geologic Cross Section: Susquehanna County



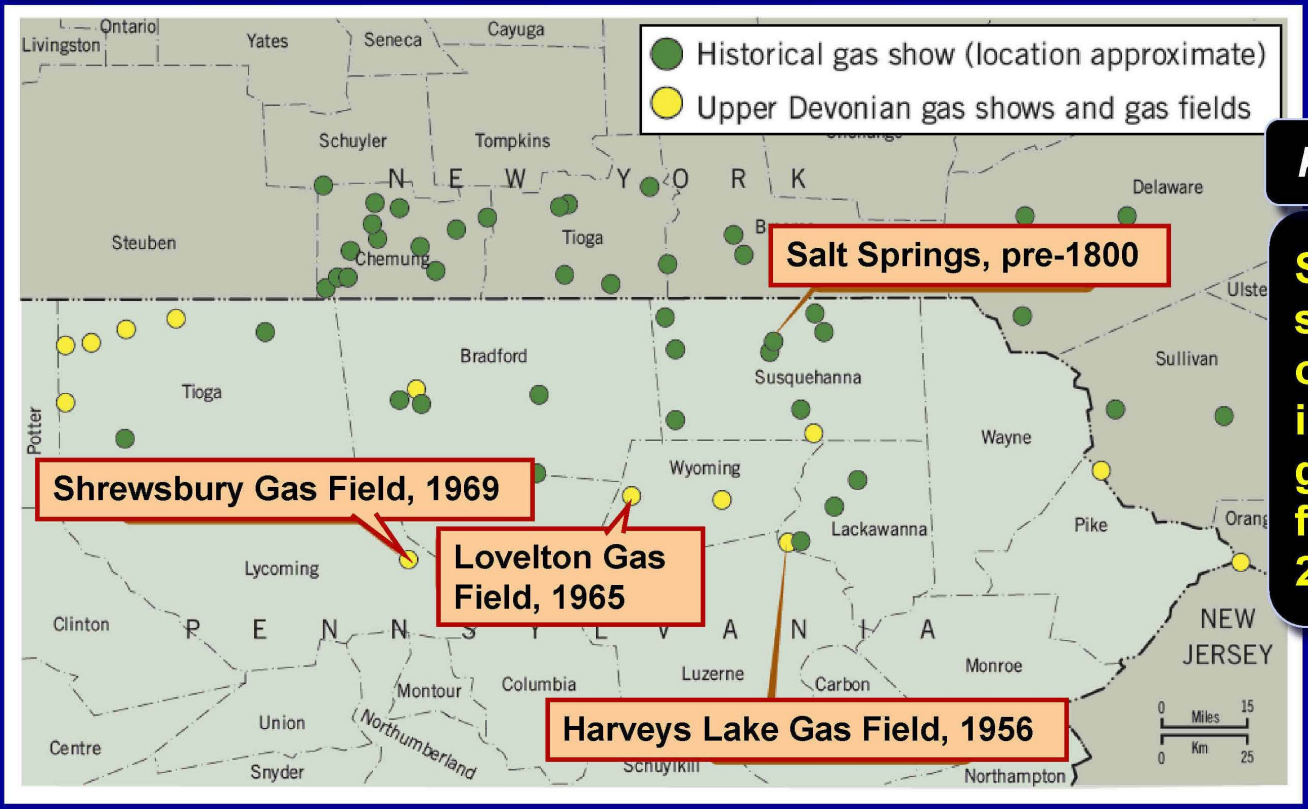
Underlying Geology of Northeastern PA



KEY POINT:

Organic seams in Catskill Sandstone formation are potential source of thermogenic gas.

Historical Gas Shows in NE Pennsylvania: *200 years*



KEY POINT:

Shallow gas shows observed in water and gas wells for over 200 years.

Duke University Study (Osborn et al., PNAS 2011)

Objective

Comparison of water quality in active vs. non-active gas extraction areas

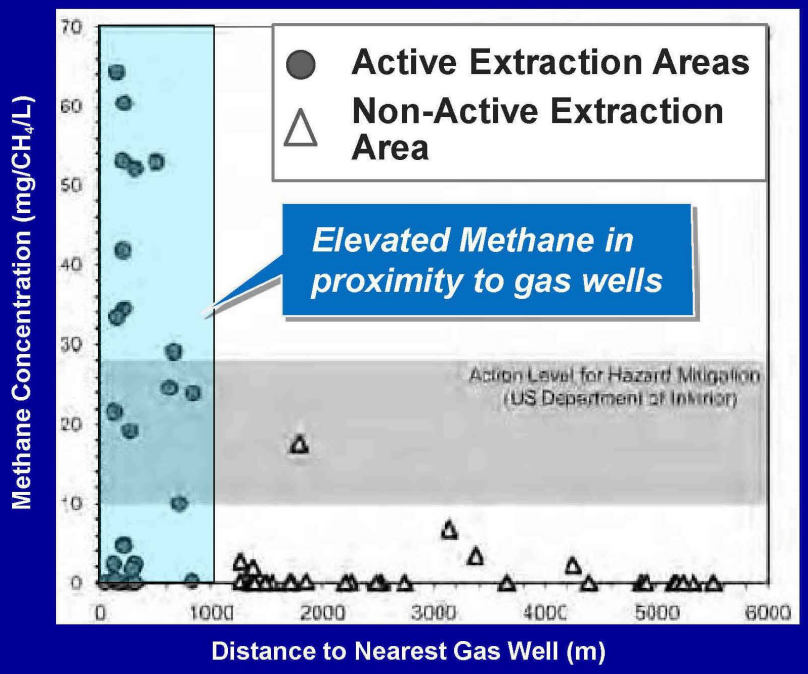
Study Area

- New York and NE Pennsylvania
- Focus Area: Susquehanna Cty, Dimock Township

Data Set

- 60 water wells
- Sampled for dissolved gas concentrations & stable isotopic signatures

Duke University Study, 2011:
Conclusions re: Methane Impacts on GW

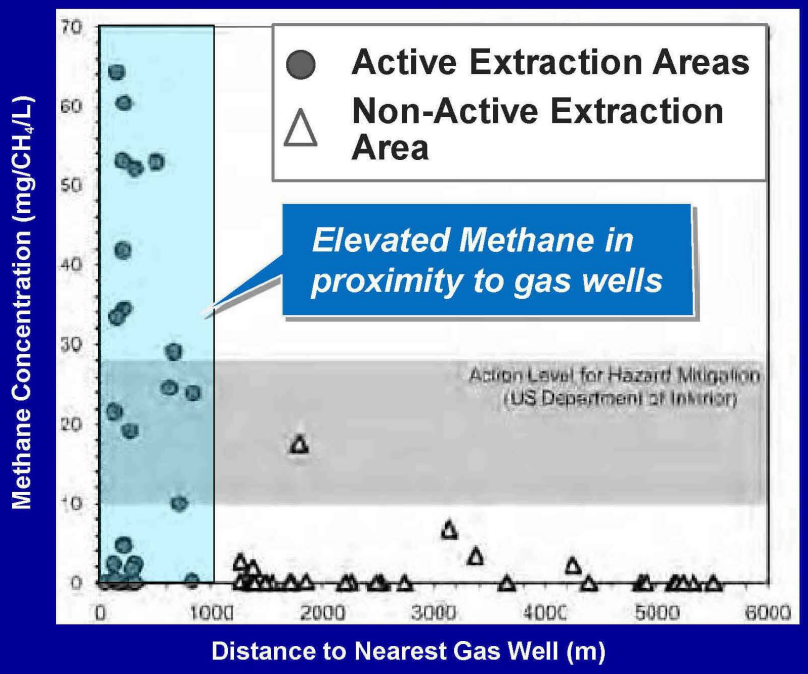


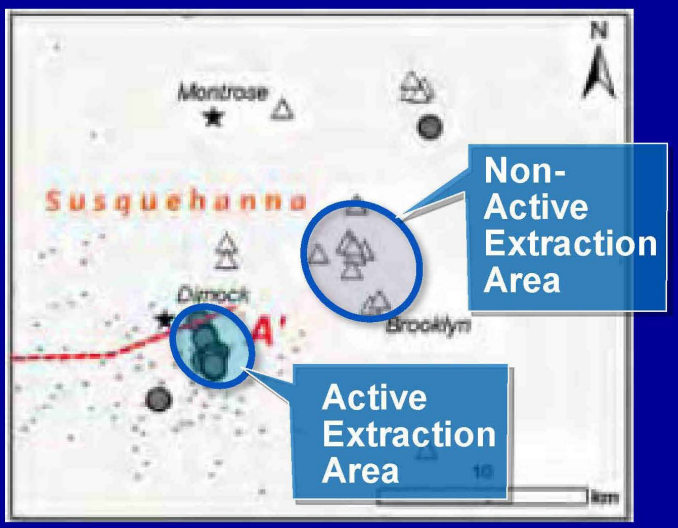
FINDINGS BY Osborn et al., 2011

- Higher methane in water wells in gas prod. zones.
- ***Active Extraction Area:*** Methane = thermogenic (Marcellus).
- ***Non-Active Extraction Area:*** Methane = microbial or microbial/ thermogenic mix.

DUKE FINDINGS: **Hydraulic fracturing and gas drilling activities are impacting water wells across region**

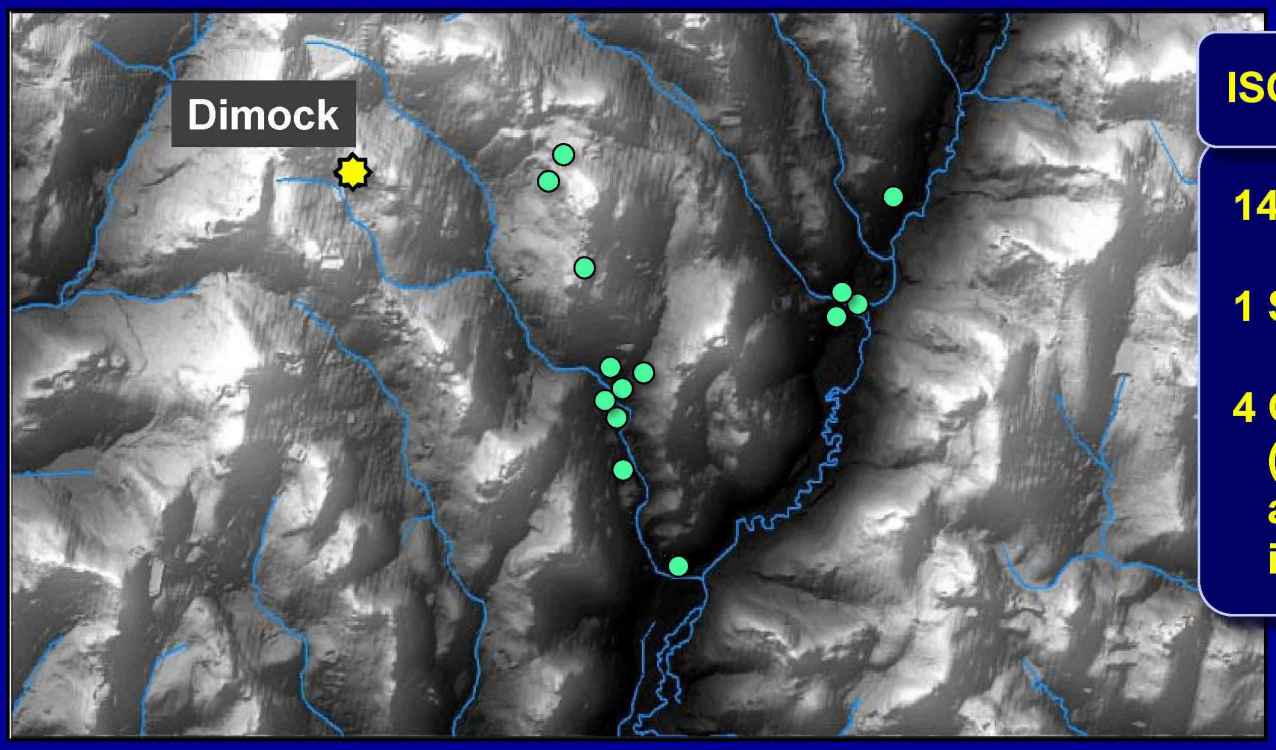
Duke University Study, 2011:
Conclusions re: Methane Impacts on GW





DUKE FINDINGS: **Higher methane levels and thermogenic signature in gas production areas suggests impact by hydraulic fracturing. (Really?)**

Molofsky et al, 2011, Article:
Isotopic Analyses of Source Gases vs. Methane in Water Wells

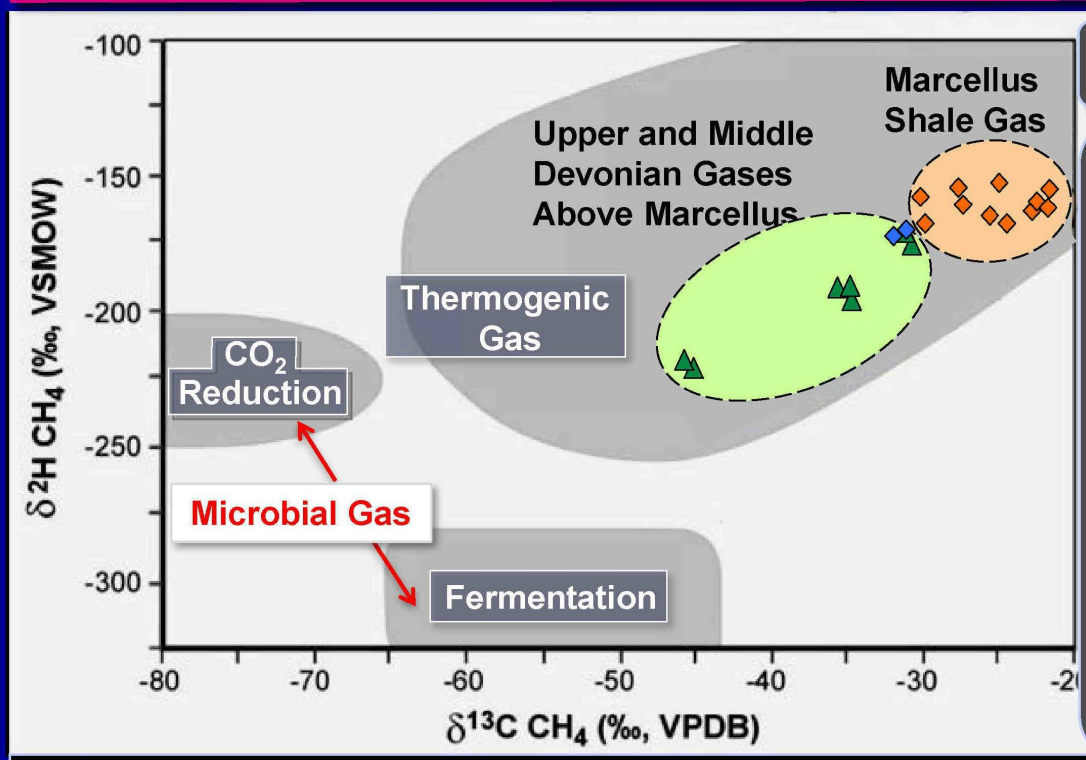


ISOTOPIC DATA

- 14 Water Wells
- 1 Salt Spring
- 4 Gas Wells (sampled at multiple intervals)

LOCATION: Susquehanna County, Dimock Township, PA

Isotope Analyses: *Source Gases*
Identified by Pennsylvania DEP and Cabot, 2008 - 11

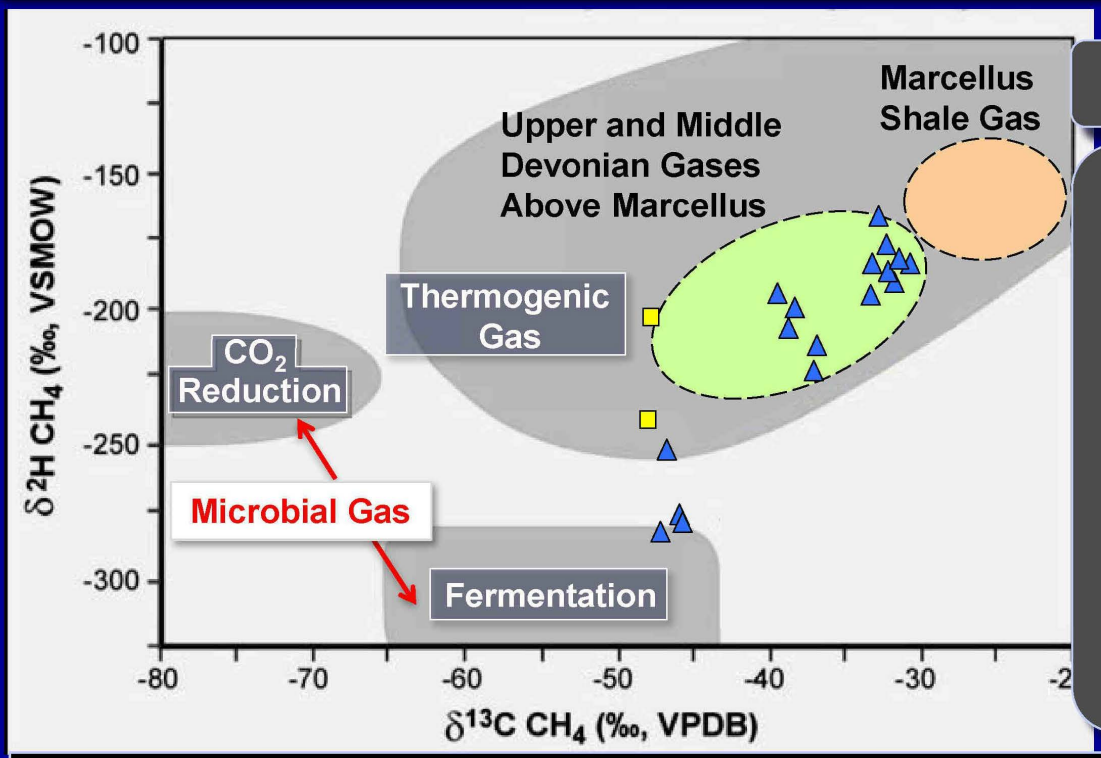


SOURCE GASES

- Marcellus Production Gas (PA DEP & Cabot)
- Upper / Middle Devonian Gas Above Marcellus (PA DEP)
- Dissolved Gas Identified as Upper/Middle Devonian (PA DEP)

KEY POINT: **Local Marcellus shale gas may be distinguished from shallower overlying Upper and Middle Devonian gases.**

Isotope Analyses: *Water Well Gases Sampled by Pennsylvania DEP and Cabot, 2008 - 11*

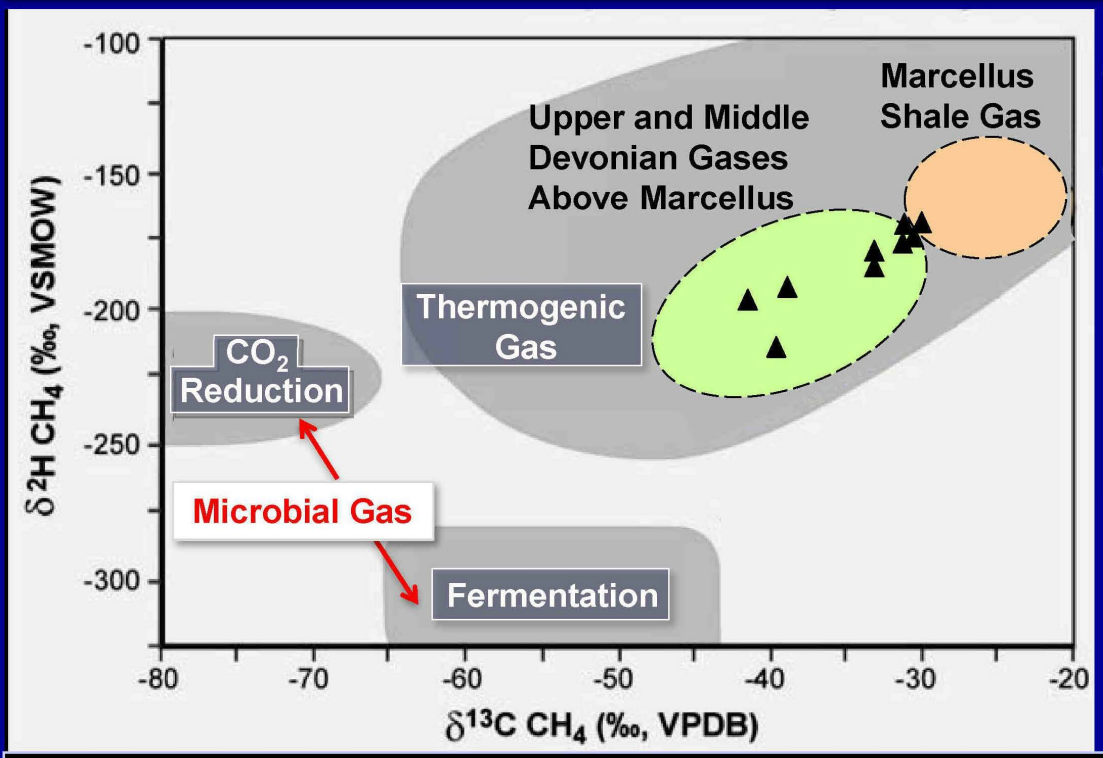


WATER SAMPLES

- ▲ Dissolved gas sampled from local water wells (PA DEP & Cabot)
- ■ Spring: Salt Springs State Park (Cabot)

KEY POINT: **Dissolved gases from local water wells are consistent with microbial or shallow thermogenic sources.**

Isotope Analyses:
Water Well Gases Sampled by Duke University, 2011



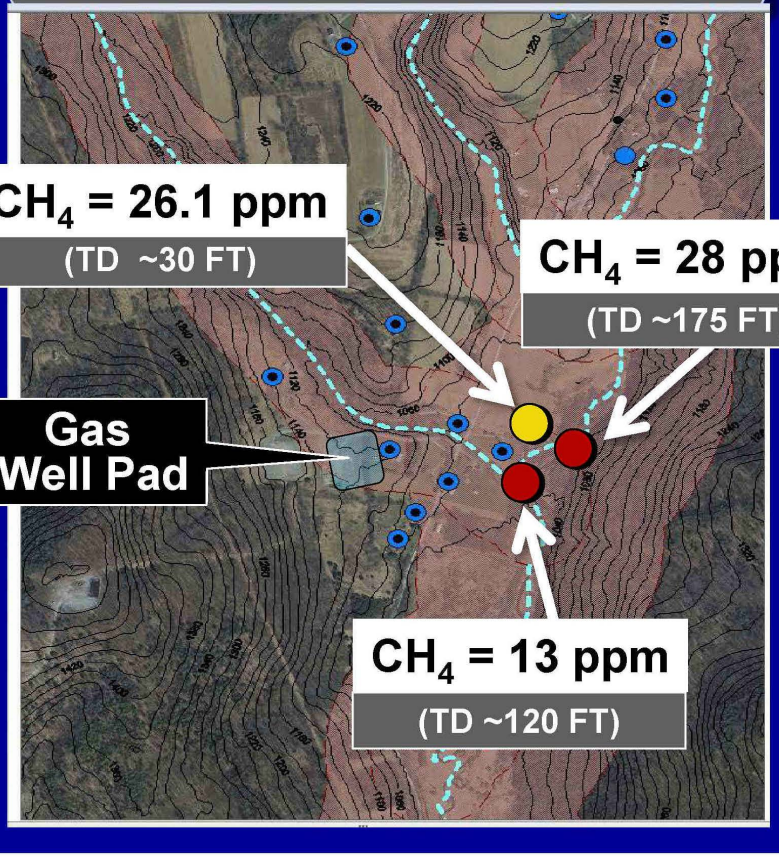
DUKE WATER WELL SAMPLES

△ **Duke Study:** Dissolved gas sampled from local water wells

KEY POINT: **Water well gases sampled by Duke are consistent with gases from Upper and Middle Devonian strata above Marcellus.**

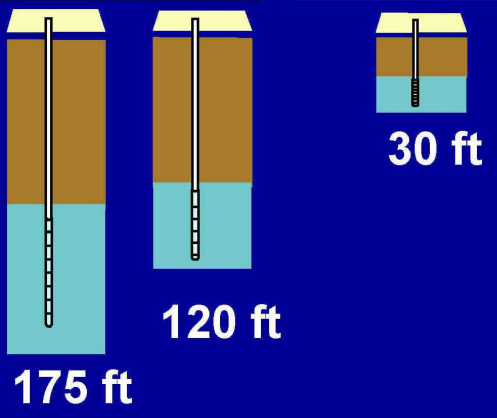
Relationship of Gas Source to Water Well Depth

Cabot Post-Drill Sampling of 3 Water Wells



Deeper Wells: Thermogenic Gas

Shallow Well: Microbial Gas/ Mix



- **Deep Water Wells** in Catskill Formation = *Thermogenic Gas*
- **Shallow Water Wells** in Glacial Till = *Microbial Gas / Mixture*

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Methane in GW in Northeastern Pennsylvania: *Key Findings*

Ubiquitous Gas	Majority of water wells contain methane
Topography	Elevated methane found in valleys vs. uplands
Prior Gas Shows	Historical evidence of shallow gas shows
Catskill Gas Accumulation	Most water wells and all gas wells penetrate Catskill formation (well construction issues)
Isotopic Signature Matches:	• Thermogenic gas from shallow Upper/Middle Devonian Formations, or • Microbial gas from alluvium

KEY POINT: **No evidence of impacts by Marcellus gas or hydraulic fracturing operations.**

U.S. EPA Action Against Range Resources:
Methane in Water Well, Parker County, TX

Background

- Elevated methane in Lipsky water well

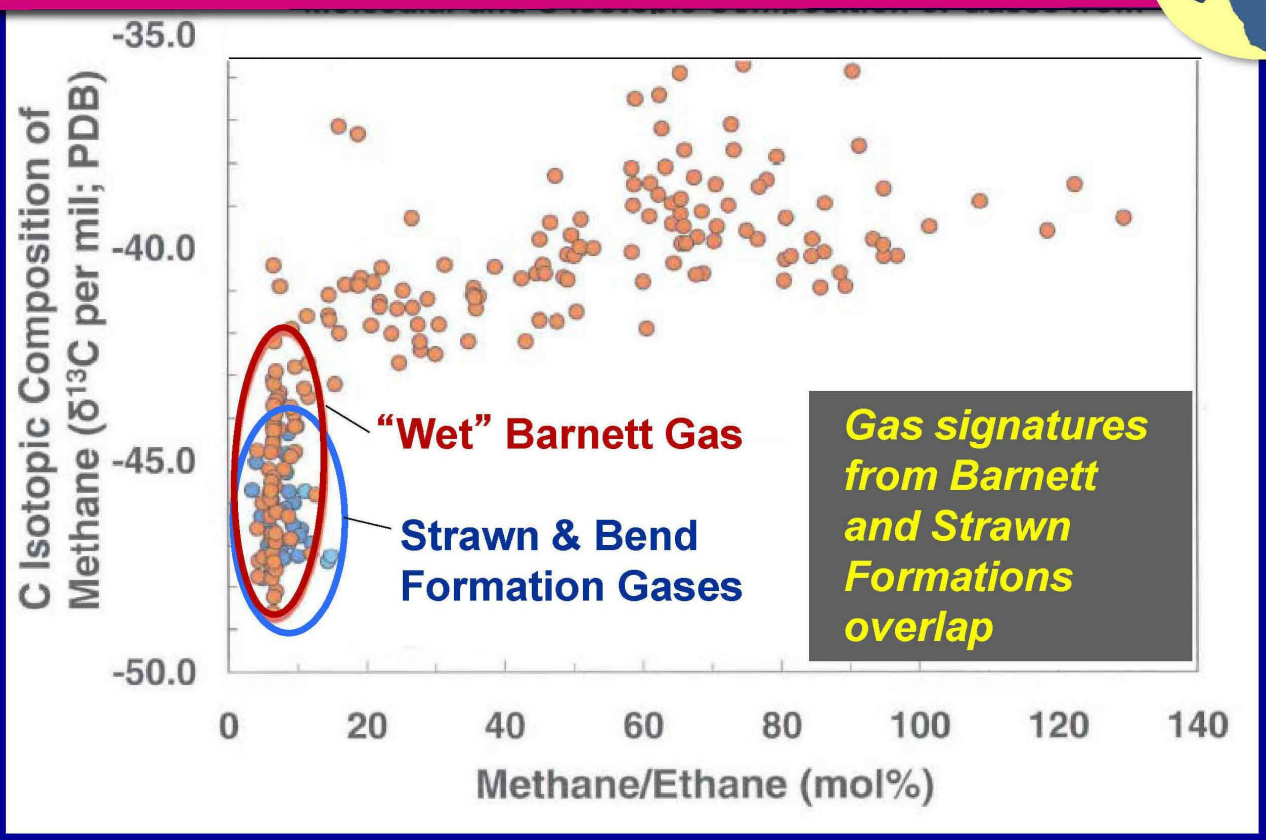
U.S. EPA Action

- Suspected methane from Barnett shale.
- Action against Operator.

Findings

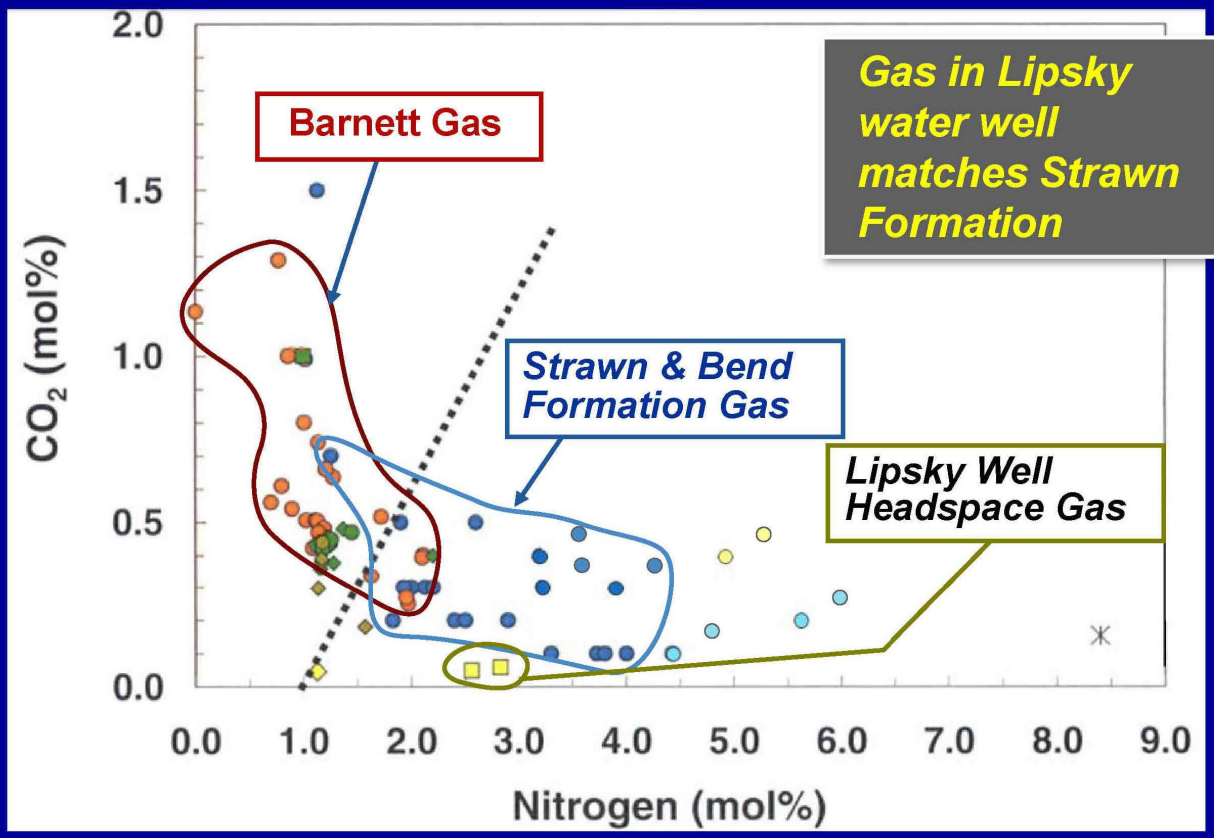
- Carbon isotopic signature does not differentiate gas from Barnett and overlying Strawn formation
- N_2 and CO_2 concentrations & N isotopic signature consistent with Strawn Formation gases, not Barnett

Carbon Isotopic Signature of Parker County, Texas, Gases: *No Distinction*



Kornacki and McCaffrey, 2011, Weatherford Laboratories

CO_2 and N Concentrations:
Source is Strawn Formation, Not Barnett



Kornacki and McCaffrey, 2011, Weatherford Laboratories

What the World Needs Now Is…

Need more effective approach to the investigation of stray gas incidents!

Credit: Bennett V/Flickr

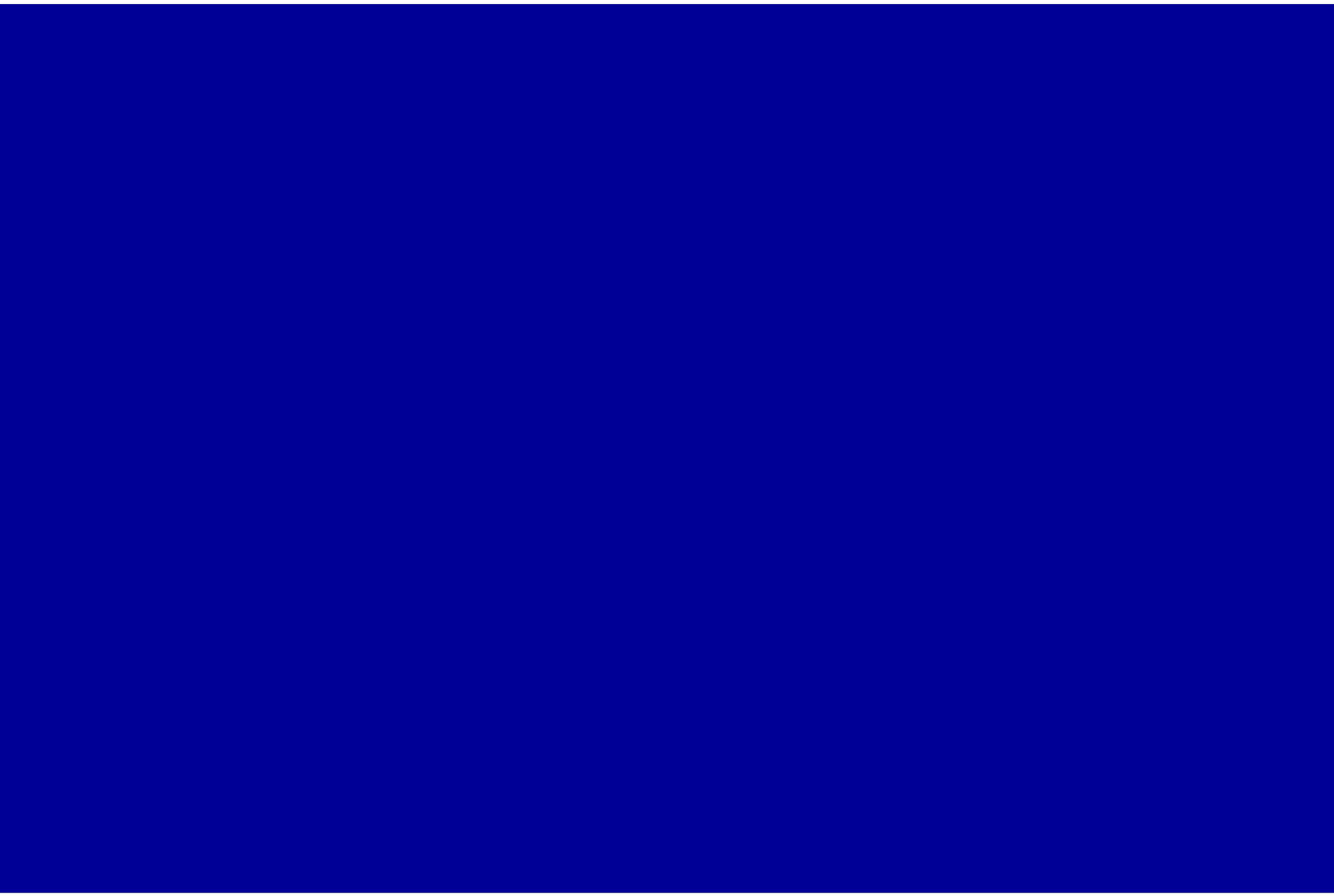
RPSEA Proposal 2012:
Stray Gas Investigation Protocol:

- ***Incentive:***
  Questionable results in recent stable isotope sourcing studies due to inconsistent methods, inadequate consideration of prior data.
- ***Key Research Issues:***
  1. Compile database of pre-drill water analyses.
  2. Develop database of source gas isotopic properties.
  3. Evaluate temporal variability.
  4. Evaluate sampling methods

RPSEA
Research Partnership to Secure Energy for America

Team Members:

- TAMU, TEEX
- TCAT
- U of Oklahoma
- Echelon
- Oil & gas operators and service companies
- Regulatory agencies



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